TITLE OF INVENTION

Non-Linear Magnetic Harmonic Motion Converter

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/289,871, filed May 9, 2001.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

BACKGROUND OF THE INVENTION

1. Field of Invention

[0003] This invention pertains to an apparatus for non-linear motion conversion using magnets that convert movement in a non-linear direction into linear or rotational motion. More particularly, this invention pertains to a plurality of magnets disposed proximal to each other for energy conversion of reciprocating non-linear or rotational movement into useful motion in rotational or linear movement.

2. Description of the Related Art

[0004] Prior magnetic drive mechanisms include a combination of a rotor and a stator with the rotor having at least one magnet thereon for rotation about the stator. According to

magnetic principles, magnetic fields of rotors and stators interact in symmetrical alignment in radial fashion and concentric relationship with a magnetically driven output shaft. Magnetic or electromagnetic components of prior magnetic drive mechanisms rotate to a top, dead or center position, utilizing skewed magnetic lines as the components seek alignment and de-energizing prior to a top, dead or center position by timing methods to allow the rotor to continue in a rotational path. In prior magnetic drive mechanisms the stator includes a plurality of inwardly oriented poles and the rotor includes a plurality of outwardly oriented poles. In basic electromagnetic motor designs, the speed of the output shaft is a function of the frequency with which the polarities and voltages are alternated in relation to proper timing of the rotation and orientation of the respective magnetic fields generated to influence the rotor and/or the stator. Timing is addressed by coil arrangements, voltage frequency, reversal of current and electronic controls known to those skilled in the art.

[0005] One example of a prior art device is an electromagnetic motor with a rotating disc and a rotating magnet on a shaft coupled to the disc. The magnetic motor includes a reciprocating magnet aligned proximal to, and movable toward and away from, the rotating magnet in order to repel the rotating magnet. The rotating magnet includes a predetermined number of permanent magnets disposed radially outward from the shaft. The rotating magnets are disposed substantially within the magnetic field of the reciprocating magnet for interaction of the magnetic fields of the rotating magnet and the reciprocating magnet through repulsion or attraction. The magnetic motor requires an actuator means and timing means for displacing the reciprocating magnetic assembly with respect to the rotating magnetic assembly to provide interaction with the magnetic fields of the rotating magnet and the reciprocating magnet to impose a rotational force on the shaft.

[0006] Another example of a prior art device is a rotor apparatus including a permanent magnet type rotating machine having a stator with armature windings thereon. The rotor includes a rotor and a plurality of permanent magnets arranged on the rotor core so as to negate magnetic flux of the armature windings passing through interpoles. The rotor is constructed so that the average of magnetic flex in an air gap between the rotor and the stator which is produced by the permanent magnets at the armature windings, provides a rotating machine which operates as an induction machine at the machine's starting and also operates as a synchronous machine at the rated driving due to smooth pull-in.

[0007] There is a need for a system for motion and force conversion that utilizes a plurality of magnets oriented for converting non-linear motion from an external energy source, into rotational motion for a pair of rotor magnets radially disposed in relation to a central magnetic element that is attracted or repulsed at multiple pivot angles to cause continuous rotary motion upon movement of the rotor magnets.

[0008] Further, it is an object of the present invention to provide an apparatus having units of motion and force conversion that are joined by stacking in parallel or by connecting in series to produce significant power outputs in relation to motion or energy inputs to each unit.

[0009] Additionally, it is an object of the present invention to provide a motion and force converter that operates without partial or incomplete strokes, and does not provide variations of amplitude by a reciprocating member where a continuous torque is desired.

BRIEF SUMMARY OF THE INVENTION

[0010] A motion and energy conversion apparatus for transferring non-linear motion of a gimbal supported magnet into rotational motion of at least one rotor magnet for producing power from the interaction of the magnetic fields of the gimbal supported magnet and the at least one rotor magnet. The motion and energy conversion apparatus includes a rotor element having at least one rotor magnet disposed to rotate in relation to an axial shaft proximal to the rotor element. The at least one rotor magnet includes a rotor magnet field defined by respective north and south poles oriented in a circumferential path of rotation about the axial shaft, with the net flux fields of the north and south poles directed substantially perpendicular to a radius from the axis of rotation of the axial shaft.

[0011] A gimbal magnet is disposed in a gimbal supported configuration to allow the gimbal supported magnet to reciprocate in relation to the axial shaft and the at least one rotor magnet. The gimbal supported magnet is positioned to extend a gimbal magnet field to the axial shaft, with the gimbal magnet field repositioned by the movements of the gimbal supported magnet. The reciprocating movement of the gimbal magnet field influences the rotor magnet field of the at least one rotor magnet with resulting rotation of the axial shaft. The gimbal supported magnet exhibits anisotropic properties having different magnetic flux field values when measured along axes in different directions. The gimbal supported magnet is reciprocated in response to non-linear motion to influence movement of at least one rotor magnet and rotation of the axial shaft. Additional embodiments include a plurality of rotor magnets disposed in spaced apart orientation along the axial shaft to provide a plurality of rotor magnet fields sufficiently proximal to the gimbal supported magnet to attract and

repulse the rotor magnets in response to movement of the gimbal supported magnet. With repeated non-linear movement of the gimbal magnet, repetitive repulsion and attraction of the rotor magnet field produces rotational movement of the axial shaft that is harnessed to perform work. The non-linear motion of the apparatus is utilizable as an energy conversion device, as a water wave energy converter, as a pumping device for movement of fluids, and/or as a generator of electrical energy.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0012] The above-mentioned features of the invention will become more clearly understood from the following detailed description of the invention read together with the drawings in which:

Figure 1a is a side perspective view of a non-linear magnetic harmonic motion converter of the present invention illustrating a gimbal supported frame member having at least one perimeter magnet mounted to reciprocate in relation to an axial shaft with at least one rotor magnet positioned on an axial shaft;

Figure 1b is side perspective view of a plurality of gimbal supported frame members, each having at least one perimeter magnet mounted thereon, and having a plurality of rotor magnets positioned on an axial shaft;

Figure 2a is a side perspective view of an alternative embodiment of Figure 1b, illustrating a gimbal supported frame member mounted to a flotation device for reciprocating motion of the plurality of gimbal supported ring magnets in relation to an axial shaft having a plurality of rotor magnets thereon;

Figure 2b is a side perspective view illustrating a connecting pivot junction for each gimbal supported ring magnet of Figure 2b;

Figure 3 is a side perspective view of an alternative embodiment of Figure 2b, illustrating a gimbal supported frame member including a second gimbal supported frame member having a ring magnet connected to move about a plurality of rotor magnets disposed on an axial shaft;

Figure 4 is a side perspective view of an alternative embodiment of Figure 2a, illustrating a gimbal supported frame member having a plurality of perimeter magnets disposed on perimeter supports, with a pair of rotor magnets disposed on an axial shaft positioned through the gimbal supported frame member;

Figure 5a is a side perspective view of an alternative embodiment of Figure 4 illustrating a base platform supporting to a gimbal supported platform having at least one ring magnet attached thereto and at least one rotor magnet disposed on an axial shaft positioned through the base platform;

Figure 5b is a side perspective view of Figure 5a illustrating a tilted gimbal supported platform attached to a tilted ring magnet;

Figure 6a is a side view of an alternative embodiment of the invention illustrating a sleeve unit rotatable about an axial shaft, with the sleeve unit having at least one rotor magnet thereon and having upper and lower linkages to platform magnets that are displaced in a gimbaled motion in relation to the axial shaft;

Figure 6b is a side view of Figure 6a, illustrating a sleeve unit in gimbal supported connection with an upper platform and a lower platform having magnets thereon, with at least one rotor magnet rotated about the axial shaft in response to the gimbaled motion of the upper and lower platform;

Figure 7a is a cross-sectional side perspective view of a pump assembly illustrating a plurality of rotatable impeller fins and a plurality of rotor magnets interdisposed between respective gimbal supported lever arms;

Figure 7b is a side perspective view of a gimbal supported lever arm of Figure 7a;

Figure 7c is a side view of one rotatable impeller fin having a pair of opposed rotor magnets thereon;

Figure 7d is a cut-away view of a fluid channel of Figure 7a, illustrating an intake channel and at least one side channels for fluid movement through the pump assembly;

Figure 8a is a cross-sectional top view of an electrical generator illustrating a plurality of rotor magnet units rotatable about separate axial shafts with induction elements interdisposed between the rotor magnet units and having a central magnet connected to a gimbal supported central shaft;

Figure 8b is a side perspective view of one rotor magnet of Figure 8a; and

Figure 8c is a side perspective view of the central magnet of Figure 8a illustrating the central magnet supported by a gimbaled connection to a central shaft.

DETAILED DESCRIPTION OF THE INVENTION

[0013] An apparatus for a non-linear magnetic harmonic motion converter **10** is disclosed as generally illustrated in Figures 1a, 1b, 2a and 2b. In one embodiment, the motion converter **10** provides conversion of non-linear, reciprocating movement into rotational motion by the interaction of first and second magnetic fields created by the north and south magnetic poles of a plurality of magnets positioned in a spaced apart configuration around an axis of rotation **32**. The motion converter **10** includes a gimbal supported ring magnet **12** disposed to reciprocate in a gimbal movement around the axis of rotation **32** that is substantially parallel to a rotational shaft **26**. The gimbal supported ring magnet **12** includes a north pole inner perimeter **14**, and a south pole outer perimeter **16**. An alternative embodiment may have the outer perimeter as the north pole and the inner perimeter as the south pole of the gimbal supported ring magnet **12**. An inner magnet ring **18** is attached around the rotational shaft **26** to tilt in different angles with the gimbal supported ring magnet **12**. The attachments for the inner magnet ring **18** include pivot connectors **20, 20'** and pivot connector bracket **22** (see Fig. 1a). Pivot connector bracket **22** includes a central passage (not shown) for insertion of the rotational shaft **26** therethrough. Disposed in spaced apart configuration along the rotational shaft **26** is at least one rotor magnet **24**, and preferably a pair of rotor magnets **24, 24'**. Upon the input of an external reciprocating force on the gimbal supported ring magnet **12**, the ring magnet **12** is reciprocatingly pivoted in a gimbal movement including varying directions **30, 30'** depending on the external force, with reciprocating pivoting of the inner magnet ring **18** depending on the orientation of the magnetic fields of the outer ring magnet **12** and the inner magnet ring **18**. As the outer ring

magnet **12** and inner magnet ring **18** reciprocate, the magnetic fields of the respective north and south poles of the outer ring magnet **12** influences the north and south magnetic fields of the pair of rotor magnets **24, 24'**, with resulting rotation **28** of the rotational shaft **26**.

[0014] The one rotor magnet **24** or the pair of rotor magnets **24, 24'** include an anisotropic permanent magnet attached to the rotational shaft **26** (see Fig. 1a). The rotor magnets **24, 24'** include respective north and south poles oriented from opposed sides of each rotor magnet **24, 24'**. The magnetic flux fields of the rotor magnets **24, 24'** are oriented in a circumferential path of rotation about the rotational shaft **26**, with the net flux fields of the north and south poles of the rotor magnets **24, 24'** directed substantially perpendicular to a radius from the axis of rotation **32** of the rotational shaft **26**. Movement **30, 30'** of the gimbal supported ring magnet **12** is effective in causing the re-orientation of the magnetic fields created by the north and south magnetic poles of the ring magnet **12**, with the attracting and repelling of the rotor magnets **24, 24'**, and rotation of the rotational shaft **26** that is harnessed to perform work.

[0015] In an alternative embodiment of a motion converter **40** (see Fig. 1b), a plurality of gimbal supported magnet rings **42, 42', 42"** are disposed to move in relation to an axial shaft **52** rotatable about an axis of rotational **66** (see Fig. 1b). Each magnet ring **42, 42', 42"** includes a north pole outer perimeter **44**, and a south pole inner perimeter **46**. An alternative embodiment may have the outer perimeter as the south pole and the inner perimeter as the north pole for each of the gimbal supported magnet rings **42, 42', 42"**. The motion converter **40** includes at least two, and preferably three or four connecting frame members **48, 48', 48", 48'''**, that are aligned in substantially parallel arraignment having a

plurality of gimbal supported magnet rings **42, 42', 42"** supported therebetween. Each respective magnet ring is attached at a plurality of pivot points **50, 50', 50"** positioned to connect on the perimeter of each magnet ring **42, 42', 42"** to maintain a pivoting connection with each respective frame member **48, 48', 48", 48'''**. An axial shaft **52** is disposed to rotate **68** within the aligned magnet rings **42, 42', 42"**. The axial shaft **52** includes a plurality of rotor magnets **54, 54', 56, 56', 58, 58'**, that are paired to extend on opposed sides of the axial shaft **52**. The magnetic flux fields of the rotor magnets **54, 54', 56, 56', 58, 58'** are oriented in a circumferential path of rotation about the axial shaft **52**, with the net flux fields of the north and south poles of the rotor magnets **54, 54', 56, 56', 58, 58'** directed substantially perpendicular to a radius from the axis of rotation **66** of the axial shaft **52**. Gimbal movement **60, 62, 64** of each respective portion of the aligned gimbal supported magnet rings **42, 42', 42"** is effective in causing the re-orientation of the magnetic fields created by the north and south magnetic poles of the magnet rings **42, 42', 42"**, and results in the creation of rotation of the rotor magnets **54, 54', 56, 56', 58, 58'** and rotation **68** of the axial shaft **52** that is harnessed to perform work.

[0016] As illustrated in Figures 2a and 2b, an alternative embodiment of the motion converter of Figures 1a and 1b includes a motion converter having a plurality of inner rings **70, 70', 70"**, each having a pivot junction with a rotating axial shaft **76** disposed within each of a plurality of outer gimbal supported magnet rings **42, 42', 42"**. Each magnet ring **42, 42', 42"** includes a north pole inner perimeter, and a south pole outer perimeter. An alternative embodiment may have the outer perimeter as the north pole and the inner perimeter as the south pole of the gimbal supported magnet rings **42, 42', 42"**. Each outer magnet ring is interconnected by a plurality of support members **48, 48', 48", 48'''** having pivot points **50,**

50' connected to each respective perimeter of each magnet ring **42, 42', 42"**. Each outer magnet ring **42, 42', 42"** is maintained apart from the axial shaft **76** by the inner rings **70, 70', 70"** that are separately connected by a pivot bracket connector **72** having a pair of extension arms **72', 72"** connected to each respective inner ring **70, 70', 70"**. The axial shaft **76** includes at least one pair of rotor magnets **54, 54'**, and preferably a plurality of rotor magnets **54, 54', 56, 56', 58, 58'**, that are paired to extend on opposed sides of the axial shaft **76**. The magnetic flux fields of the rotor magnets **54, 54', 56, 56', 58, 58'** are oriented in a circumferential path of rotation about the axial shaft **76**, with the net flux fields of the north and south poles of the rotor magnets **54, 54', 56, 56', 58, 58'** directed substantially perpendicular to a radius from the axial shaft **76**. As illustrated in Figure 26, a flotation device **80** may encircle the motion converter. The device **80** may include a central housing (not shown) that is releasably attachable by a plurality of connector members radially extended from the interior of the flotation device **80**, to connect the central housing around the motion converter including a plurality of gimbal supported magnet rings **42, 42', 42"**. One or more of the gimbal supported magnet rings **42, 42', 42"** may be attached to the central housing of the flotation device **80**, in order to allow at least one or more of the magnet rings **42, 42', 42"** to freely reciprocate in response to movement of the flotation device **80**. An alternative embodiment includes a cylindrical housing (not shown) or a spherical housing (see Fig. 3) that is releasably attachable within the flotation device **80**, with the motion converter suspended interior of the housing that is preferably water-tight. As the flotation device **80** is moved in a non-linear motion by waves of a body of water, the gimbal supported magnet rings **42, 42', 42"** are moved, with re-orientation of the respective magnetic fields of the magnet rings **42, 42', 42"** and alternating attracting and repelling of rotor magnets **54,**

54', 56, 56', 58, 58', with resulting rotation of the rotor magnets **54, 54', 56, 56', 58, 58'** and rotation of the axial shaft **76**. The rotation of the axial shaft **76** may be harnessed by connection to a rotational motion conversion device (not shown) and associated electrical circuitry (not shown) for conversion of rotation of motion into electrical energy for storage or for powering of audio or visual alarm equipment attached to the flotation device **80**. A weight **78** may be attached to a lower end of the motion converter, opposite the end attached to the flotation device **80**, to maintain the motion converter in an upright position regardless of the turbulence created by waves of the body of water.

[0017] As illustrated in Figure 3, an alternative embodiment of Figure 2a and 2b includes a harmonic motion converter **100** including a cylindrical housing **102** enclosing an outer gimbal supported magnet ring **104** having north and south poles on respective outer and inner perimeters of the magnet ring **104**. The magnet ring **104** is free to move **118, 118'** in a gimbal-like manner within the cylindrical housing **102** in one embodiment, or in an alternative embodiment is attachable at two positions along the outer perimeter of the gimbal ring magnet **104** by pivot connections (not shown) to an interior surface of the cylindrical housing **102**. Within the outer gimbal ring magnet **104** is disposed an inner ring **106** that is attached by at least two pivot points by pivot arms **112, 112'''** to an interior perimeter of gimbal ring magnet **104**, so that inner ring **106** is pivotable within outer gimbal ring magnet **104**, which is reciprocatingly moved **118, 118'** in a gimbal-like manner in relation to cylindrical housing **102**. Inner ring **106** may include north and south poles, either along respective inner and outer perimeter of the inner ring **106**, or reversed in polarity, or may have one portion of the inner and outer perimeter of the inner ring **106** having a north polarity, and an opposed portion of the inner perimeter and outer perimeter of the inner ring

106 having a south polarity (not shown). Inner ring **106** is attached by at least two pivot arms 112', 112" to a connector sleeve **110**. Supported by the connector sleeve **110** within the inner ring **106** is an axial shaft **108** that is rotatable in relation to the inner ring **106** and the outer gimbal ring magnet **104**. One rotor magnet **116**, or preferably a pair of rotor magnets **116, 116'** are disposed in opposed orientation along the axial shaft **108**. Reciprocating movement of the circular housing **102** is effective in causing the re-orientation of the magnetic fields created by the north and south magnetic poles of the gimbal ring magnet **104**, and the north and south magnetic poles of the inner ring **106**, resulting in the creation of rotation of the rotor magnets **116, 116'** and rotation of the axial shaft **108**, providing rotational movement that is harnessed to perform work or is converted by circuitry into electrical energy for storage or for powering audio and/or visual devices. A counterweight **114** is attachable in alignment with the axis of rotation of the axial shaft **108**, to maintain the outer gimbal ring magnet **104**, the inner ring **106**, and the axial shaft in substantially upright position regardless of the rotation of the cylindrical housing **102** caused by turbulence created by waves of the body of water, or rolling of the cylindrical housing **102** along a path on land or within an enclosing machinery unit.

[0018] As illustrated in Figure 4, an alternative embodiment of a harmonic motion converter **130** includes a first outer gimbal ring magnet **132**, and inner ring magnet **134** pivotably supported within the outer gimbal ring magnet **132** by a pivot bracket **136** having connecting arms**136', 136"** and outer connector arms **138, 138'**. Outer gimbal ring magnet **132** is connected by a plurality of pivot connections **154** to a plurality of perimeter support frame members **152** that are substantially aligned to encircle first outer gimbal ring magnet **132**, and second outer gimbal ring magnet **142** that is pivotably connected by a plurality of

pivot connections **156** to the plurality of perimeter support frame members **152**. A second inner ring **144** is pivotably supported within the second outer gimbal ring magnet **142** by a pivot bracket **146** having connecting arms **146'**, **146"** and by outer connector arms **148, 148'** to second outer gimbal ring magnet **142**. An axial shaft **140** is disposed through pivot brackets **136** and **146**, with the axial shaft having at least one pair of rotor magnets **160, 160'** disposed in opposed orientation thereon. The axial shaft **140** and rotor magnets **160, 160'** are freely rotatable **162** in relation to first outer gimbal ring magnet **132** and second outer gimbal ring magnet **142**. Lateral rotation **164** and/or vertical movements **158** of perimeter support frame members **152** create movement of each of the aligned gimbal supported magnet rings **132**, **142,** causing the re-orientation of the magnetic fields created by the north and south magnetic poles of the ring magnets **132**, **142**, resulting in the creation of rotation of at least one pair of rotor magnets **160, 160'**, and the rotation of the axial shaft **140** that is harnessed to perform work or transfer of rotational energy at opposed end **140'** of the axial shaft **140**.

An alternative embodiment of the harmonic motion converter of Figure 4, or other embodiments disclosed herein, includes the plurality of perimeter magnets **150** including a plurality of electromagnets (not shown) disposed on respective perimeter support member, with each electromagnet connected electrically to circuitry and a power means for timing the electrical pulses to each electromagnet, thereby providing a timed, repetitive change in the electrical pulses to each electromagnet for repetitively changing the north and south polarity of each of the perimeter located electromagnets. With each change in polarity of the electromagnets, a re-orientation of the respective electromagnetic fields occurs to provide a means for reciprocating the polarity of the electromagnetic fields, therefore inducing rotation

of rotor magnets **160**, **160'** and corresponding rotation **162** of axial shaft **140** to perform work.

[0019] An alternative embodiment of the harmonic motion converter **170** is illustrated in Figures 5a and 5b, including one outer gimbal ring magnet **172**, and inner ring magnet **174** pivotably supported within the outer gimbal ring magnet **172** by a pivot bracket **176** having connecting arms **176'**, **176"**. Extended outwardly from the outer perimeter of the outer gimbal ring magnet **172** is at least two pivot arms **178**, **178'**, which extend on opposed sides of the outer perimeter for positioning the ring magnet **172** between respective pairs of guide channels **190'** and **190"** that extend upwards from a platform base **190**. The perimeter of the outer gimbal ring magnet **172** is pivotably attached by pairs of connector pivots **186**, **186'**, **186"**, **186'''** (not shown) to a plurality of perimeter support frame members **182**, **182'**, **182"**, and **182'''** (see Figs. 5a and 5b). An upper platform **188** is attached in a concentric and spaced apart orientation from the outer gimbal ring magnet **172** , with the outer perimeter of the upper platform attached to respective perimeter support frame members **182**, **182'**, **182"**, **182'''** by pairs of connector pivots **184**, **184'**, **184"**, **184'''** (not shown). An axial shaft **180** is rotatable **196** in relation to the pivot bracket **176** and the platform base **190**. At least two rotor magnets **180'** and **180"** are disposed in spaced apart positions along the axial shaft **180**. Rotor magnets **180', 180"** may be oriented between a range of about 90 degrees to about 180 degrees separation from each other, or any alternative angle of separation that allows the axial shaft **180** to remain balanced during rotation **196**. A second position of the upper platform and outer gimbal ring magnet **172** is illustrated in Figure 5b, demonstrating vertical movement **194**, in addition with angled tilting upwards **192** and downwards **192'** of the gimbal ring magnet **172** and platform **188**, with the re-orientation of the magnetic fields

created by the north and south magnetic poles of the gimbal ring magnet **172**, and resulting in the creation of rotation of at least one pair of rotor magnets **180'**, **180"**, and resulting in rotation **196** of the axial shaft **180** to perform work.

[0020] An alternative embodiment of a mechanism for use in the motion converters disclosed herein is a sleeve bracket **210** illustrated in Figures 6a and 6b. The sleeve bracket **210** includes a sleeve bearing **212** having at least one rotor magnet **220** extended therefrom. The sleeve bearing **212** is rotatable **222** about an axial shaft **218**, and is restrained from moving up or down along the axial shaft 218 by respective raised spacers **224**, **224'**. The axial shaft **218** is attachable between a first gimbal connector **214** and a second gimbal connector **216**. The gimbal connectors **214**, **216** are attached to respective first supporting platform **226** and second supporting platform **228**. First supporting platform **226** is free to rotate and/or reciprocate **226'**, **226"** in spaced apart orientation from the rotation of second supporting platform **228** and/or reciprocation **228'**, **228"**. The north and south poles of the rotor magnet **220** are oriented to rotate in a circumferential path of rotation about the axial shaft **218**, with the net flux fields of the north and south poles directed substantially perpendicular to a radius from the axis of rotation **222** around the axial shaft **218**. Figure 6b illustrates the potential movements **226'**, **226"** of first platform **226** having north and south magnet poles thereon, and the movements **228'**, **228"** of second platform **228** having north and south magnet poles thereon, with resulting attracting and repelling of the rotor magnet **220** and resulting rotation **222** of sleeve bearing **212** to perform work, move fluids, and/or to power an electrical generator.

[0021] An alternative embodiment of the motion converter is illustrated in Figures 7a – 7d, illustrating a motion converter operating as a pump assembly **230** for movement of fluids through a housing **232** utilizing a plurality of rotatable rotor magnet and impeller units **242** including pairs of opposed impeller fins **246, 246', 246"** (see Fig. 7c) having at least one rotor magnet fin **244**, and preferably two opposed rotor magnet fins **244, 244'**, interposed between the impeller fins (see Fig. 7c). The impeller fins **246, 246', 246"** are mounted in a radially extended orientation to rotate **270** around an axial shaft **248** similar to a paddle wheel configuration that is positioned within a plurality of channels within the housing **232**. The plurality of fluid channels include paired channels **236, 236', 238, 238', 240, 240'**, each include an impeller unit **242** therein. Each pair of channels **236, 236', 238, 238', 240, 240'** are interconnected by side flow channels **266, 266'** (see Figs. 7a & 7d), to allow fluid that enters through input channels **234, 234', 234"** to flow through respective side flow channels **266, 266'**, past each rotatable impeller unit **242**, through respective central channels **268**, for movement into, and out of, annulus channel **262**.

[0022] Each pair of opposed rotor magnet fins **244, 244'** includes respective north and south poles oriented in a circumferential path of rotation about each axial shaft **248** (see Fig. 7c). The net flux fields of the north and south poles of each pair of rotor magnet fins **244, 244'** are directed substantially perpendicular to a radius from the axis of rotation of the axial shaft **248**. The housing **232** includes a central fluid annulus **262** for flow of fluid out of the housing **232** upon the activation and rotation **270** of respective rotatable rotor magnet and impeller units **242**. The housing **232** includes a plurality of magnet channels **264, 264', 264"** angled radially outwards from a central non-linear pivot axis **260** within a central opening **260'**. Each magnet channel **264, 264', 264"** contains a gimbal connected magnet **252**

therein, with each magnet **252** connected in a cantilevered position to a rigid, or alternatively a flexible shaft **254, 254', 254"** that is connected to the central non-linear pivot axis **260** (see Fig. 7b). Each of the gimbal connected magnets **252, 252', 252"** are disposed to reciprocate in a non-linear direction within each respective magnet channel **264, 264', 264"**, in response with reciprocation of central non-linear pivot axis **260**. Figure 7b illustrates reciprocation **272, 272'** of each respective magnet **252, 252', 252"** in response to non-linear movement **274, 274'** of the central non-linear pivot **260**. A connector joint **258** may be utilized to connect each shaft **254, 254', 254"** to the central non-linear pivot **260**. Upon non-linear movement of the central non-linear pivot **260**, each respective magnet **252, 252', 252"** is reciprocated within each respective magnet channel **264, 264', 264"**, with resulting repositioning of the magnet fields from each respective magnet **252, 252', 252"** and resulting in rotation of each rotatable rotor magnet **244, 244'** and impeller unit **242** having respective impeller fins **246, 246', 246"** for movement of fluids through respective fluid channels **236, 236', 238, 238', 240, 240'** and into central fluid annulus **262** for movement of fluid out of the housing **232**. Flow may be reversed by changing the magnetic poles of the stator magnets **244, 244'** and/or changing the magnetic pole orientation of the magnets **252, 252', 252"** within the respective magnet channels **264, 264', 264"**. The housing **232** is stackable with like configured housings (not shown) to provide for additional capacity for pumping liquids.

[0023] An alternative embodiment of the motion converter for utilization as an electrical generator **310** is illustrated in Figures 8a – 8c. Figure 8a is a top view of an electrical generator **310** having a housing **312** with a plurality of rotor magnet units **320** positioned to rotate within channels **316** oriented in a radial configuration in the housing **312**. Each rotor magnet **322** of each rotor magnet unit **320** is rotated about a respective axial shaft

328 due to the influence of a changing magnetic flux field generated by non-linear movement of a central magnet **332**, and the magnetic attracting or repelling of opposed pairs of stator magnets **330, 330', 330"** positioned at a perimeter of the housing **312**. Each of the rotor magnet units **320** are disposed to rotate within each channel **316** that is radially oriented in relation to a central channel **318** within the housing **312** in which the central magnet **332** is disposed to move. Each of the opposed pairs of stator magnets **330, 330', 330"** are disposed in respective perimeter channels **314** that are in spaced apart orientation along the perimeter of the housing **312**. Each rotor magnet unit **320** includes either a two-sided magnet (not shown), a three-sided magnet having a north and south pole on opposed, angled surfaces, or a multi-sided rotor magnet **322** having a north and south magnetic pole positioned on a perimeter surface of the rotor magnet **322**. One configuration of the north and south magnetic poles include a north pole side **324**, a south pole side **326**, a north pole end surface **324'**, and a south pole end surface **326'** on surfaces of each rotor magnet **322** as illustrated in Figure 8b. Alternative orientations of north and south magnetic poles for each rotor magnet **322** may be utilized as known by one skilled in the art. The respective north and south poles are oriented in a circumferential path of rotation about the axial shaft **328**, with the net flux fields of the north and south pole end surfaces **324', 326'** directed substantially perpendicular to a radius from each axial shaft **328** around which each rotor magnet **322** rotates within each respective channel **316**. Each channel **316** is oriented to extend radially away from the central magnet **332** positioned centrally in the housing **312** (see Fig. 8a). A counter-weight (not shown), or an additional magnet (not shown) may to attached to each axial shaft **328** in an opposed orientation from each respective rotor magnet **322**. The rotation **340** of each rotor magnet **322** is induced by the non-linear movement of the central magnet **332**, which

includes outer perimeter and inner perimeter surfaces having respective north and south poles as illustrated in Figure 8c. Central magnet **332** is connected to a pair of pivot connections **334, 334'** that are connectable to a central axis **336** that is reciprocated in multiple directions **338, 338'** by an external force imposed on central axis **336**. Upon receipt of reciprocating motion along the central axis **336** and transmission by the pair of pivot connections **334, 334'** of motion to the central magnet **332,** the resulting repositioning of the respective north and south magnetic fields associated with central magnet **332** induces rotation of each rotor magnet **322** by repetitive attracting and repelling of the north and south poles of each rotor magnet **322**, resulting in rotational movement **340** for each axial shaft **328**. Rotation of each axial shaft **328** is converted by conversion devices and electrical circuitry (not shown) known to those skilled in the art, to provide electrical energy for power supply applications or for recharging of electrical energy storage units (not shown). In an alternative embodiment, the north and south poles of central magnet **332** are switched in orientation on respective inner perimeter and outer perimeter surfaces. In an additional alternative embodiment, each pair of stator magnets **330, 330', 330"** may be connected by a perimeter connector bracket (not shown) to allow reciprocating movement induced by external forces for movement of each pair of stator magnets **330, 330', 330"** in relation to each respective rotor magnet unit **320.**

[0024] An alternative embodiment of the motion converter for utilization as an electrical generator **310** includes a housing **312** in which a plurality of magnetic induction units **342** and a plurality of electromagnetic elements **344** (see Fig. 8a) are disposed between the plurality of rotor magnet units **320** within separate channels **316**. The magnetic induction units **342** are connectable to electric power timing circuitry (not shown) to generate and to provide pulsed electrical current to each electromagnet element **344** for re-orientating of the

respective north and south magnetic fields of each electromagnet element **344**, thereby inducing rotational movement **340** for each rotor magnet **322**. The plurality of rotor magnet units **320** are rotated **340** about the axial shaft **328** due to the influence of the changing magnetic flux field generated by non-linear movement of the central magnet **332**, and by the re-orientating of the north and south magnetic fields of the electromagnetic elements **344**. Rotation **340** of each rotor magnet **322** is converted by conversion devices and electrical circuitry (not shown) known to those skilled in the art, to provide electrical energy for power supply applications or for recharging of electrical energy storage units (not shown).

[0025] From the foregoing description, it will be recognized by those skilled in the art that a non-linear magnetic harmonic drive motion converter apparatus has been provided. For embodiments connecting to motors and pumps for conversion of non-linear motion into rotational motion, the present invention provides simplicity of structure and provides a highly adaptable and efficient apparatus. Additional embodiments are utilized for motors, positioning devices, battery recharging units, gear actuation devices, transit and conveying components, motion conversion, drive-trains, drive motors for water craft, and harnessing of energy from wave motion in aquatic environments.

[0026] While the present invention has been illustrated by description of several embodiments and while the illustrative embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and methods, and illustrative examples shown and

described herein. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept as described in the appended claims.